

Pemecahan kasus Muatan Listrik

1. Seorang remaja putri menggunakan cincin yang terbuat dari perak ($^{107,9}_{47}\text{Ag}$) dan dilapisi emas ($^{197}_{79}\text{Au}$) 0,8 gram, massa cincin tersebut 5 gram. Berapa jumlah elektron dalam cincin remaja putri tersebut.

Penyelesaian :

Atom Ag memiliki 47 elektron dan massa 107,9 gram/mol.

Atom Au memiliki 79 elektron dan massa 197 gram/mol.

Massa emas = 0,8 gram, karna massa cincin 5 gram maka massa perak = 4,2 gram.

Jumlah atom dalam 0,8 gram emas dan 4,2 gram perak :

$$N = 0,8 \text{ g} \frac{6,02 \cdot 10^{23} \text{ atom/mol}}{197 \text{ g/mol}} + 4,2 \text{ g} \frac{6,02 \cdot 10^{23} \text{ atom/mol}}{107,9 \text{ g/mol}}$$

$$N = 2,44 \cdot 10^{21} \text{ atom} + 2,34 \cdot 10^{22} \text{ atom}$$

$$N = 2,584 \cdot 10^{22} \text{ atom}$$

Setiap atom mempunyai 126 elektron, jadi

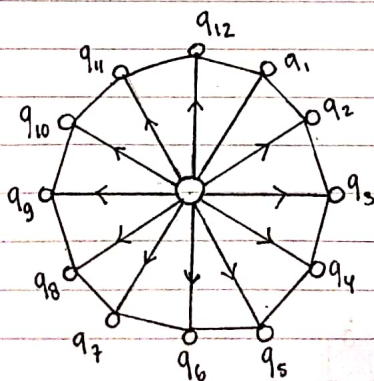
$$Q = (2,584 \cdot 10^{22} \text{ atom})(126 \text{ elektron/atom})(1,60 \cdot 10^{-19} \text{ C/elektron})$$

$$Q = 5,2 \cdot 10^5 \text{ C}$$

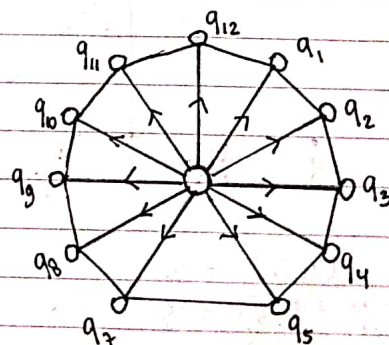
Jadi, untuk untuk 5 gram cincin mempunyai muatan $5,2 \cdot 10^5 \text{ C}$, hal ini berarti bahwa dalam 5 gram cincin terdapat $5,2 \cdot 10^5 \text{ C} / 1,6 \cdot 10^{-19} = 3,25 \cdot 10^{24}$ elektron.

Kasus Gaya Listrik

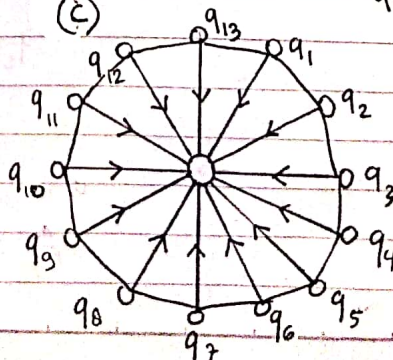
(a)



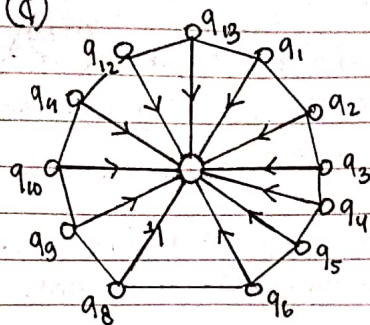
(b)



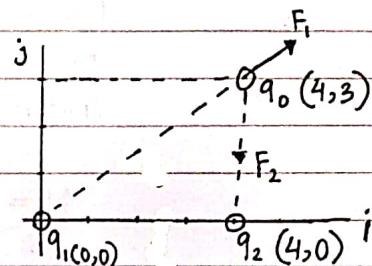
(c)



(d)

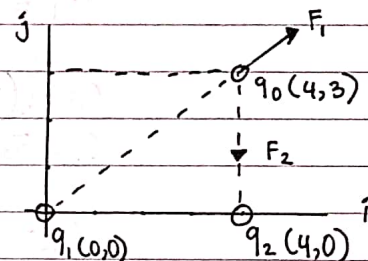
(e) $q_1 = 25 \text{ MC} \rightarrow (0,0)$ $q_2 = -10 \text{ MC} \rightarrow (4,0)$ $q_0 = 10 \text{ MC} \rightarrow (4,3)$ Gaya pada $q_0 \rightarrow \vec{F} = q_0 k \left[\frac{q_1}{r_{q_1}^2} \hat{r}_{q_1} + \frac{q_2}{r_{q_2}^2} \hat{r}_{q_2} \right]$

$$\vec{F} = 10 \cdot 9 \cdot 10^9 \left\{ 25 + \frac{(-10)}{16} (i) \right\}$$

(f) $q_1 = +25 \text{ MC} \rightarrow (0,0)$ $q_2 = -10 \text{ MC} \rightarrow (4,0)$ $q_0 = +20 \text{ MC} \rightarrow (4,3)$

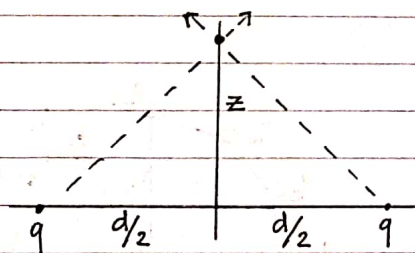
$$\vec{F} = q_0 k \left[\frac{q_1}{r_{q_1}^2} \hat{r}_{q_1} + \frac{q_2}{r_{q_2}^2} \hat{r}_{q_2} \right]$$

$$\vec{F} = 20 \cdot 9 \cdot 10^9 \left\{ 25 + \frac{(-10)}{16} (i) \right\}$$



Kasus Medan Listrik

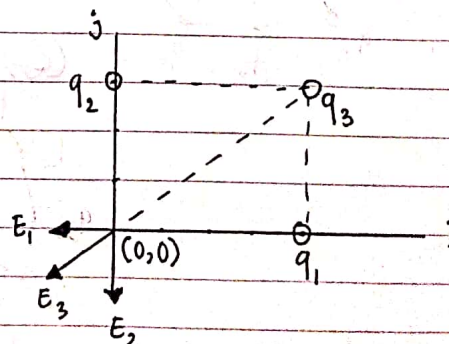
(a)



(b)

 $q_1 (4,0) = 2 \text{ C}$ $q_2 (0,3) = 5 \text{ C}$ $q_3 (4,3) = 10 \text{ C}$ Medan listrik posisi $(0,0)$

$$E_1 = \frac{1}{4\pi\epsilon_0} \frac{2}{16} (j)$$



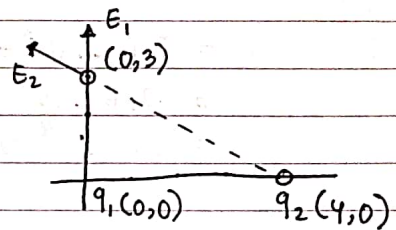
medan oleh q_2 : $\vec{E}_2 = \frac{1}{4\pi\epsilon_0} \frac{5}{9} (i)$

medan oleh q_3 : $\vec{E}_3 = \frac{1}{4\pi\epsilon_0} \frac{10}{25} \left(\frac{4i + 3j}{5} \right)$
 $= \frac{1}{4\pi\epsilon_0} \left(\frac{40}{125} i + \frac{30}{125} j \right)$

medan total : $\vec{E} = \frac{1}{4\pi\epsilon_0} \left[\left(\frac{5}{9} + \frac{40}{125} \right) i + \left(\frac{2}{16} + \frac{30}{125} \right) j \right]$

$\vec{E} = \frac{1}{4\pi\epsilon_0} \sqrt{(0,47)^2 + (0,8)^2} = 8,35 \times 10^3 \text{ N/C}$

(c) $q_1 = -5 \mu\text{C} \rightarrow (0,0)$
 $q_2 = 10 \mu\text{C} \rightarrow (4,0)$



medan oleh q_1 : $\vec{E}_1 = \frac{1}{4\pi\epsilon_0} \frac{5}{25} \left(\frac{4i + 3j}{5} \right)$
 $= \frac{1}{4\pi\epsilon_0} \left(\frac{20}{125} i + \frac{15}{125} j \right)$

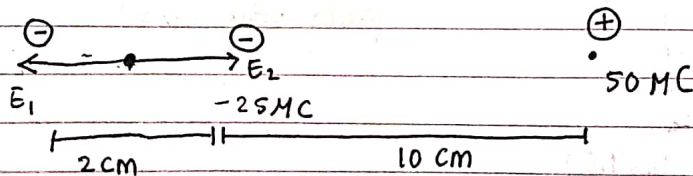
oleh q_2 : $\vec{E}_2 = \frac{1}{4\pi\epsilon_0} \frac{10}{16} (j)$

Total $\vec{E} = \frac{1}{4\pi\epsilon_0} \left[\left(\frac{20}{125} (i) + \left(\frac{10}{16} + \frac{15}{125} \right) j \right) \right]$

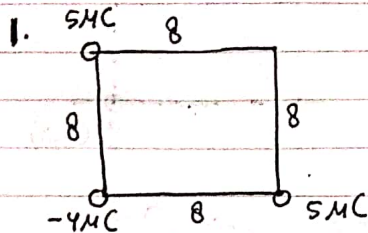
$= \frac{1}{4\pi\epsilon_0} \sqrt{(0,16)^2 + (0,74)^2}$

$= \frac{1}{4\pi\epsilon_0} \sqrt{0,573}$

(d) a.



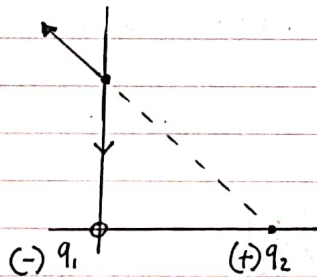
Potensial Listrik



$$V_{\text{total}} = \sum k \frac{q}{r}$$

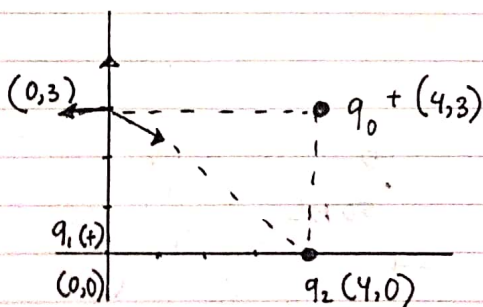
$$\begin{aligned}
 &= 9 \cdot 10^9 \cdot \frac{5 \cdot 10^{-6}}{8} + \frac{5 \cdot 10^{-6}}{8} \cdot 9 \cdot 10^9 - \frac{4 \cdot 10^{-6}}{8\sqrt{2}} \cdot 9 \cdot 10^9 \\
 &= 5,62 \cdot 10^3 + 5,62 \cdot 10^3 - 6,36 \cdot 10^3 \\
 &= 17,6 \cdot 10^3 \\
 &= 1,76 \cdot 10^4 \text{ Volt}
 \end{aligned}$$

2.



$$\begin{aligned}
 V &= \frac{kq_1}{r_1} + \frac{kq_2}{r_2} \\
 &= 9 \cdot 10^6 \left(\frac{5}{3} + \frac{10}{4} \right) \\
 &= 3,75 \times 10^7 \frac{\text{dyne cm}}{\mu\text{C}}
 \end{aligned}$$

3.



$$\begin{aligned}
 q_1 &= (0,0) \rightarrow 25 \mu\text{C} \\
 q_2 &= (4,0) \rightarrow -15 \mu\text{C} \\
 q_0 &= (0,3) \rightarrow 20 \mu\text{C} \\
 &\text{pada titik } (0,3)
 \end{aligned}$$